CEILING SYSTEM WITH TECHNOLOGY

CROSS-REFERENCE TO RELATED APPLICATIONS

This International Application is based upon and claims priority of United States Provisional Patent Application Serial No. 60/408,183 filed September 4, 2002.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

REFERENCE TO A MICROFISHE APPENDIX

Not applicable.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to overhead systems for architectural interiors and, more particularly, to a system of supported shields which permit the use of LED and other lighting elements with selectable materials surrounding the lighting elements in various configurations, so as to provide desired degrees of translucence, light intensity, texture and diffusion.

Background Art

Architectural infrastructure continue to evolve in today's commercial, industrial, residential and office environments. For purposes of description in this specification, the term "architectural interiors" shall be used to collectively designate these environments. Historically, and particularly beginning with the industrial revolution, interiors often consisted of large rooms with fixed walls, ceilings and doors. Architectural interiors would often include large and heavy desks, worktables, machinery, assembly lines or the like, depending upon the particular environment. Lighting, heating and cooling (if any) functions were often centrally controlled.

With the exception of executive offices, privacy for face-to-face or telephone conversations, meetings or other commercial interior activities was difficult to achieve. Of course, until the past several decades, and with the exception of telephones and typewriters, there was no need to configure interiors to facilitate usage of other office equipment, such as computers, copying and facsimile machines. In general, occupants of such architectural interiors had no significant control over their environments. Also, given the use of stationary walls, permanent ceilings and heavy office and industrial equipment, any reconfiguration of an architectural interior was a time consuming and costly undertaking.

During the middle of the Twentieth century, architectural interiors began to acquire somewhat of a more "sophisticated" infrastructure design, particularly with respect to office environments. In part, this was caused by office automation with the advent of electronic copy machines, teletypes, electric typewriters and the like. The office "layout" needed to take into account greater needs for electrical power and configurations for supplying power to appropriate locations. Also, "shared" equipment, such as copy machines and teletypes, required consideration of centralized locations (and "common space") and high voltage power supplies. During this time, thought was also given to environmental concerns in architectural interiors, such as appropriate air ventilation. Although building owners and tenants began to concern themselves with the foregoing, architectural interiors still typically involved very heavy and relatively "stationary" furniture and fixed ceilings (the ceilings being "fixed" in size, position, structure, make-up and color). Lighting, heating and the early forms of air conditioning also continued to be controlled through central and often remote locations.

A further advance in architectural interiors began in the 1960's. Several furniture makers began work on systems having elements which provided at least a minimum level of

individual privacy, and defined an individual's "workspace." Some of these elements were designed to provide electrical power (interconnected to the building's power supplies) located at an occupant's workspace. Hanging and supporting bracket structures were developed to provide means for interconnecting furniture accessories (such as shelving, cabinets or worksurfaces) to stationary walls or to the space dividers themselves. As these systems evolved, they included arrangements for use with specific utilitarian elements, such as computer stands, keyboard drawers and the like.

In general, these types of systems as developed over the past several decades can be somewhat characterized as providing a "kit of parts," comprising repeated parts for the occupants or users. Although these systems permit "partial" rearrangement of architectural interiors, they did not fit within a true definition of a "modular" system. Instead, these system are inherently "closed systems," and are limited to finite sets of interchangeable physical parts.

Further, these systems typically do not address issues associated with ceiling structures, such as interchangeability, lighting, acoustical properties and the like. With respect to ceiling structures, architects and designers are beginning to look at various types of new designs for purposes of enhancing acoustical properties, lighting efficiency and aesthetics. Numerous types of ceiling structures are known in the prior art which are particularly directed to acoustical properties. One well known ceiling structure is the Armstrong drop ceiling, utilizing opaque ceiling shielding elements modularly supported within a T-bar structure. These ceilings are manufactured by Armstrong World Industries, Inc. Such structures have to accommodate ceiling lighting (if desired), HVAC ducts, fire sprinklers and similar environmental and safety systems. Relatively recently, architects and designers have introduced "open" architecture ceilings that expose structure, even in commercial and office environments. With such exposed ceiling

architecture, providing "drop-downs" for HVAC duct work, fire sprinklers, power supplies and the like is not a significant problem. However, open ceiling architecture can present problems with respect to acoustical properties and, for some, may not be aesthetically pleasing.

In addition to the foregoing issues, many known ceiling structures are substantially difficult to reconfigure, once initially assembled and put into place. Accordingly, with this difficulty of reconfiguration, corresponding difficulties arise in the event that modifications are required in lighting, HVAC duct work or sprinkler locations. In addition, reconfiguration of most known ceiling structures may involve substantial expense. Also, as with other elements of known architectural interiors, reconfiguration may require substantial time and involve personnel having technical expertise.

Lighting associated with such structures also has the same problems with respect to potential need for change. Also, when ceiling systems are first designed by the designers, architects and engineers, it may be several years before the building is actually commissioned and tenants occupy the building. At that time, the needs of the tenants may be relatively diverse from the designer's original lighting schema. Further, lighting needs may vary for different functions. However, most known ceiling lighting structures are relatively constant with respect to their light intensity, and the diffusion which may be associated with the lighting. It would be advantageous to have means for varying the light intensity, color, texture and diffusion associated with the lighting.

Other issues also arise with respect to ceiling structures. For example, safety concerns are of primary importance. Fire protection and other building codes may require materials from which ceiling structures are constructed to be treated with fire retardant or fire

resistant materials. In addition, the ceiling structure materials themselves may be constructed of fireproof or fire resistant elements.

Other disadvantages exist with respect to current ceiling systems. For example, most known systems do not have the capability of any rapid reconfiguration in "appearance." It would be advantageous, for example, to modify ceiling appearances for "personal" design, the identity of a particular meeting group or the like. Such changes in appearance could include rearrangement of lighting, modifications in color intensity, texture, translucence and diffusion, and images which may be projected upon or transmitted from ceiling systems. Still further, known ceiling systems do not lend themselves to interchangeability of ceiling system components. In addition, known ceiling systems do not have the capability of modifications in color, configuration and the like based on external environmental characteristics, such as time of day, particular season and other changes. In this regard, for example, health experts have found that lighting has effects on both physical and mental health of individuals.

Still further, many of the architectural interiors in existence today actually result in an "overperformance." That is, ceilings have weight, bulk and other size parameters which are clearly unnecessary for their desired functionality. Their cost is significant. This cost occurs not only from initial acquisition prices, but also, as a result of their lack of true flexibility, from costs associated with moving or reconfiguring the ceiling systems. Also, in part, additional costs result from the fact that reconfiguration of such ceiling systems often results in wastes of component parts. In this same regard, many component parts of known systems are not reusable when disassembled.

Still further, known ceiling systems for many reasons (including those previously stated herein), do not lend themselves to any type of "rapid" reconfiguration. In fact, they may

require a significant amount of work to reconfigure. This work often requires use of trained specialists. Also, reconfiguration of known ceiling systems may involve additional physical wiring or substantial rewiring for their lighting. Different trained specialists may be required when the reconfiguration in any manner involves such electrical or data/communications components. Still further, although these ceiling systems may involve lighting controllable by a workspace user, many environmental functions remain centrally controlled, often in locations substantially remote from the architectural interior being controlled.

Even further, however, difficulties can arise in known ceiling systems when environmental characteristic control is provided within a general space of an occupant. For example, lighting associated with an occupant's ceiling may be controlled by a switch which is initially relatively close in proximity and readily accessible. However, if the lighting is moved to different ceiling areas, the switch controlling the lighting may no longer be located in a functionally "correct" position. In this regard, known systems have no capability of providing any relatively rapid reconfiguration of controlling/controlled relationships among functional elements, such as switches, ceiling lights and the like. Also, to the extent these relationships are reconfigured, substantial rewiring by personnel having significant technical expertise will be required.

Another significant disadvantage with known ceiling systems relates to their lack of development in light of advances in technology. However, many of these technological advances have modified today's business, educational and personal work practices. Two examples of relatively recent technological advances consist of the semiconductor revolution and the corresponding miniaturization of numerous electrical and data/communications components. Today, the work practices of many individuals may involve the need for changing space

appearance through LED lighting and digital imagery. However, most of today's ceiling systems do not provide for availability of such features. In addition, known systems do not provide any other features which will facilitate efficiency in today's new work practices, such as digital programming of lighting.

The foregoing is only a brief description of some of the disadvantages associated with current development in architectural interiors and ceiling systems. In part, disadvantages exist because of today's business practices. The following paragraphs briefly describe other aspects of today's activities in the areas of architecture and design, and why the foregoing disadvantages of known ceiling systems are becoming even more important.

In the past, problems associated with difficulty in reconfiguration of architectural interiors, and lack of <u>in situ</u> control of a location's environmental conditions, may not have been of primary concern. However, today's business climate often involves relatively "fast changing" architectural interior needs. Ceiling systems may be structurally designed by designers, architects and engineers, and initially laid out in a desired format with respect to support, lighting fixtures and other functional accessories. However, when these structures, which can be characterized as somewhat "permanent" in most buildings (as described in previous paragraphs herein), are designed, the actual occupants may not move into the building for several years. Designers need to "anticipate" the needs of future occupants of the building being designed. Needless to say, in situations where the building will not be commissioned for several years after the design phase, the ceiling systems of the building may not be appropriately laid out for the actual occupants. That is, the prospective tenants' needs may be substantially different from the designers' anticipated ideas and concepts. However, as previously described herein, most architectural interiors permit little reconfiguration after completion of the initial design.

Reconfiguring of ceiling systems in accordance with the needs of a particular tenant can be extremely expensive and time consuming. During structural modifications, the architectural interior is essentially "down" and provides no positive cash flow to the buildings' owners.

It would be advantageous to always have the occupants' activities and needs "drive" the structure and function of the architectural interior layout. To date, however, many relatively "stationary" (in function and structure) interiors essentially operate in reverse. That is, it is not uncommon for prospective tenants to evaluate a building's architectural interiors and determine how to "fit" their needs (workspaces, conference rooms, lighting, heating, ventilation and air conditioning ("HVAC") requirements and the like) into the existing architectural interiors.

Still further, and again in today's business climate, a prospective occupant may have had an opportunity to be involved in the design of a building's architectural interior, so that the interior is advantageously "set up" for the occupant. However, many business organizations today experience relatively rapid changes in growth, both positively and negatively. When these changes occur, again it may be difficult to appropriately modify the architectural interior so as to permit the occupant to expand beyond its original architectural interior or, alternatively, be reduced in size such that unused space can be occupied by another tenant.

The foregoing paragraphs describe ceiling system reconfiguration as a result of delay time between original design and the time when users actually occupy space, as well as situations where reconfiguration is required as a result of a business organization's growth or other "external" conditions requiring reconfiguration. In addition, it would also be advantageous to reconfigure ceiling systems substantially on a "real time" basis, where the needs of the occupants change almost instantaneously. That is, the time period required for reconfiguration

need not be of any substantial length of otherwise involve changes in a business climate for a particular occupant.

As an example, it may be advantageous for the occupant of a particular architectural interior to have a specific ceiling system layout during morning and evening hours, while having a revised layout during mid-day hours. This could occur, for example, in an educational learning center, where usage of the architectural interior by students may change, for example, from primarily "individual" usage in the morning and evening hours, to joint projects and meeting activities requiring collaborative usage during mid-day hours. For such usage, it may be particularly advantageous to have the capability of rapidly modifying ceiling system colors, lighting characteristics and the like.

Other problems also exist with respect to the layout and organization of today's architectural interiors. For example, and as earlier described herein, accessories such as switches and lights may be relatively "set" with regard to locations and particular controlling relationships between such switches and lights. That is, one or more particular switches may control one or more particular lights. To modify these control relationships in most architectural interiors requires significant efforts. In this regard, a ceiling system can be characterized as being "delivered" to original occupants in a particular "initial state." This initial state is defined by not only the physical locations of functional accessories, but also the control relationships among switches, lights and the like. It would be advantageous to provide means for essentially "changing" the relationships in a relatively rapid manner, without requiring physical rewiring or similar activities. In addition, it would also be advantageous to have the capability of modifying physical locations of various functional accessories, without requiring additional electrical wiring, substantial assembly or disassembly of component parts, or the like. Still further, it

would be advantageous if users of a particular area could effect control relationships among functional accessories and other utilitarian elements at the location of the ceiling system itself.

In regard to the aforedescribed issues, a number of systems have been developed which are directed to one or more of these issues. For example, Jones et al., U.S. Pat No. 3,996,458, issued December 7, 1976, is primarily directed to an illuminated ceiling structure and associated components, with the components being adapted to varying requirements of structure and appearance. Jones et al. disclose the concept that the use of inverted T-bar grids for supporting pluralities of pre-formed integral shielding elements in well known. Jones et al. further disclose the use of T-bar runners having a vertical orientation, with T-bar cross members. The runners and cross members are supported by hangers, in a manner so as to provide an open space or plenum thereabove in which lighting fixtures may be provided. An acrylic horizontal sheet is opaque and light transmitting areas are provided within cells, adding a cube-like configuration. Edges of the acrylic sheet are carried by the horizontal portions of the T-bar runners and cross runners.

Balinski, U.S. Pat No. 4,034,531, issued July 12, 1977 is directed to a suspended ceiling system having a particular support arrangement. The support arrangement is disclosed as overcoming a deficiency in prior art systems, whereby exposure to heat causes T-runners to expand and deform, with ceiling tiles thus falling from the T-runners as a result of the deformation.

The Balinski ceiling system employs support wires attached to its supporting structure. The support wires hold inverted T-runners, which may employ enlarged upper portions for stiffening the runners. An exposed flange provides a decorative surface underneath the T-runners. A particular flange disclosed by Balinski includes a longitudinally extending

groove on the underneath portion, so as to create a shadow effect. Ceiling tiles are supported on the inverted T-runners and may include a cut up portion, so as to enable the bottom surface to be flush with the bottom surface of the exposed flange. The inverted T-runners are connected to one another through the use of flanges. The flanges provide for one end of one inverted T-runner to engage a slot in a second T-runner. The inverted T-runners are connected to the decorative flanges through the use of slots within the tops of the decorative flanges, with the slots having a generally triangular cross-section and with the inverted T-runners having their bottom cross members comprising opposing ends formed over the exposed flange. In this matter, the inverted T-runners engage the tops of the exposed flanges in a supporting configuration.

Balinski also shows each decorative exposed flange as being hollow and comprising a U-shaped member, with opposing ends bent outwardly and upwardly, and then inwardly and outwardly of the extreme end portions. In this matter, engagement is provided by the ends of the inverted T-runner cross members. A particular feature of the Balinski arrangement is that when the system is subjected to extreme heat, and the decorative trim drops away due to the heat, the inverted T-configuration separates and helps to hold the ceiling tiles in place. In general, Balinski discloses inverted T-runners supporting ceiling structures.

Balinski et al., U.S. Pat No. 4,063,391, issued December 20, 1977, shows the use of support runners for suspended grid systems. Each support runner includes a spline member. An inverted T-runner is engaged to the spline, in a manner so that when the ceiling system is exposed to heat, the inverted T-runner continues to hold the ceiling shielding elements even, although the spline loses structural integrity and may disengage from the trim.

Csenky, U.S. Pat No. 4,074,092, issued February 14, 1978, discloses a power track system for carrying light fixtures and a light source. The system includes a U-shaped

supporting rail, with limbs of the same being inwardly bent. An insulating lining fits into the rail, and includes at least one current conductor. A grounding member is connected to the ends of the rail limbs, and a second current conductor is mounted on an externally inaccessible portion of the lining that faces inwardly of the rail.

Botty, U.S. Pat No. 4,533,190, issued August 6, 1985, describes an electrical power track system having an elongated track with a series of longitudinal slots opening outwardly. The slots provide access to a series of offset electrical conductors or bus bars. The slots are shaped in a manner so as to prevent straight-in access to the conductors carried by the track.

Greenberg, U.S. Pat No. 4,475,226, issued October 2, 1984, describes a sound and light track system, with each of the sound or light fixtures being independently mounted for movement on the track. A bus bar assembly includes power bus bar conductors.

SUMMARY OF THE INVENTION

In accordance with the invention, a ceiling system is provided, for use with a supporting infrastructure. The supporting infrastructure provides for distribution of electrical power and for a communications network, and comprises a plurality of frames and cross frames. More specifically, the ceiling system includes a plurality of shielding elements supported within the frames and cross frames. A series of lighting elements are electrically coupled and energized through the electrical power distribution. The lighting elements are adjacent to or otherwise incorporated within the shielding elements. The shielding elements are movably mounted to the supporting infrastructure, and are constructed of materials which may be of varying degrees of translucence. In this manner, intensity, color and diffusion of lighting projected from the lighting elements may be adjusted.

The ceiling system and the supporting infrastructure can be suspended from a building roof or similar overhead structure through the use of cable elements. The cable elements may be adjusted so as to adjust the height of the supporting infrastructure and, therefore, the mounted ceiling system. Further, means can be provided for adjusting the position of the ceiling system relative to the supporting infrastructure. The ceiling system materials are constructed and configured so as to permit commercial interior utilities to extend downwardly below a plane substantially formed by the series of shielding elements. Further, the series of lighting elements and the plurality of shielding elements are manually removable from the supporting infrastructure. More specifically, the series of lighting elements may comprise a series of LED module lighting strips. Further, the lighting elements may include other types of lighting, such as fluorescent, metal halide or similar lighting elements.

The supporting infrastructure comprises parallel and spaced apart rails, and the shielding elements are supported on sides of adjacent rails on pairs of opposing L-shaped brackets. The shielding elements are releasably secured to the L-shaped brackets through securing means. Further, to the extent that the panels comprise solid infill panels, they can comprise acoustic ceiling shielding elements having materials for providing sound absorption.

The shielding elements may comprise air-filled cellular structures. Further, the shielding elements may comprise 3D-Pongi fabric. In another embodiment in accordance with the invention, the shielding elements may comprise rigid fins. Still further, the shielding elements may comprise heliofon fabric fins.

The shielding elements may be supported on opposing lateral sides through the use of a frame of the supporting infrastructure. The frame may be constructed of a variety of materials, including extruded aluminum. Further, the shielding elements may be supported from

overhead building supports through the use of suspension cables interconnected directly to the shielding elements. These suspension cables may be adjustable in length.

In accordance with another aspect of the invention, the cross frames may be interconnected to other components of the ceiling system through the use of brackets. A plurality of members may be positioned in a spaced apart and parallel configuration along the shielding elements. The lighting elements can comprise LED lighting modules mounted on undersides of the members. The shielding elements can comprise a series of light bags having varying degrees of translucency. The light bags can provide modifications to light intensity and varying degrees of translucency and diffusion with respect to the LED lighting modules or other lighting elements. Still further, each of the members may be elongated in length and laterally extend across at least one of the shielding elements. Each of the LED lighting modules may be linear in configuration, and mounted to an underside of a corresponding one of the members. Further, each of the lighting modules may include a series of LED's spaced apart along a length of a corresponding one of the lighting modules. Still further, a plurality of the LED lighting modules may be coupled to at least one of the members.

In accordance with a further aspect of the invention, the lighting elements may comprise linear LED lighting modules flexible in construction. Low voltage DC power may be applied from the electrical power distribution of the supporting infrastructure. Still further, the ceiling system may comprise power transformers interconnected to the distribution of electrical power and to the lighting elements for supplying low voltage DC power to the lighting elements. Still further, the ceiling system may comprise at least one bus bar for supplying low voltage DC power to the lighting elements.

In accordance with a further aspect of the invention, the shielding elements may comprise light diffusing fabric fins, in association with light bags. The lighting elements can include a series of LED members, with each member having a linear LED lighting module secured to an underside thereof. Each of the linear LED lighting modules can comprise a series of spaced apart LED lights. A series of the light bags are suspended from the members. The light bags may comprise light diffusion heliofon fabric.

Still further, the shielding elements may comprise light diffusing fabric fins. The light diffusing fabric fins may be in the form of singular light sheets. Further, the light sheets may comprise light diffusing heliofon fabric.

In accordance with another aspect of the invention, the shielding elements may comprise rigid fins having a "deep triangle" configuration. Still further, the rigid fins may be constructed of translucent Lexan® material. The term Lexan® is a registered trademark of the General Electric Company. The shielding elements may also comprise a pair of relatively long rigid fins, essentially forming a rectangular configuration. A rigid fin of relatively shorter length may be positioned intermediate the two rigid fins. The relatively long rigid fins and the rigid fins of relatively shorter lengths may separate a series of linear LED lighting modules from each other. The relatively long rigid fins and the rigid fins of relatively shorter length may be constructed of a translucent Lexan® material.

In accordance with a further aspect of the invention, the shielding elements may comprise a series of rigid fins forming a rectangular configuration around individual ones of the linear LED lighting modules. The linear LED lighting modules may be turned on their sides, so that strips of individual LED's have different directional configurations. The rigid fins may be constructed of a translucent Lexan® material.

In accordance with another aspect of the invention, the shielding elements may comprise a series of parallel and spaced apart linear air tubes. The lighting elements may comprise linear LED lighting modules spaced intermediate the linear air tubes. Further, the linear air tubes may be constructed of a polyethylene material. In accordance with another aspect of the invention, the lighting elements may comprise a series of round marker LED lighting modules. The round marker LED lighting modules may be positioned adjacent the linear air tubes.

Still further, the shielding elements may comprise a series of air pillows. The lighting elements may then comprise a series of round marker LED lighting modules positioned adjacent the air pillows. The air pillows may be constructed of a polyethylene material.

In accordance with a further aspect of the invention, the shielding elements may comprise a series of woven fabric materials. The woven fabric materials may be suspended from the supporting infrastructure in a manner so as to provide a "wave" pattern. The lighting elements may comprise a series of LED lighting modules positioned above the woven fabric materials. Still further, the ceiling system may comprise means for circulating forced air around the fabric materials. The woven fabric materials may than be coupled to the supporting infrastructure in a manner so as to permit generation of "pulsing" curvatures of the woven fabric materials in response to the circulating forced air.

The shielding elements may be coupled to the supporting infrastructure through flexible or hinged means. In this manner, the shielding elements may be suspended in varying angular orientations.

In accordance with a still further aspect of the invention, the ceiling system can comprise a set of utilitarian elements associated with the ceilings. At least certain of the utilitarian elements may be manually releasable from the shielding elements.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The invention will now be described with reference to the drawings, in which:

FIG. 1 is a perspective, diagrammatic illustration of a ceiling system located above a particular spatial area having various functions;

FIG. 2 is a perspective view of a series of shielding elements in accordance with the invention, suspended from a rail system;

FIG. 3 is a perspective view of shielding elements similar to FIG. 2, but with the shielding elements being suspended from cables;

FIG. 4 is a section view of FIG. 2, illustrating certain aspects of the LED lighting and ceiling, with the concept that single or a plurality of LED's may be utilized for possible color changing or the like;

FIG. 5 is a section view of FIG. 2, showing the cable suspensions and further showing aspects of the LED lighting and ceiling;

FIG. 6 is a perspective of ceiling components in accordance with the invention, and comprising what is characterized as an LED or member having a linear LED lighting module associated therewith;

FIG. 7 is a perspective view similar in scope to FIG. 6, but showing the use of a pair of linear LED lighting modules with the LED member;

FIG. 8 is a perspective view similar in scope to FIGS. 6 and 7, but showing the use of the LED member with three linear LED lighting modules;

FIG. 9 is an underside view of the LED member of FIG. 8;

FIG. 10 illustrates a generally elevational view of a linear LED lighting module, detached from the LED member;

FIG. 11 is a side elevation cross section similar in scope to FIG. 4, but showing the use of a power transformer;

FIG. 11A is a sectional end view of the LED lighting module and connector elements associated therewith, taken along section lines 11A-11A of FIG. 11;

FIG. 12 is a perspective view of a first embodiment of a ceiling configuration in accordance with the invention, showing the combination of the actual shields and the LED lighting modules;

FIG. 13 is a cross sectional view of the first embodiment illustrated in FIG. 12;

FIG. 14 is a perspective view of a second embodiment of a ceiling configuration in accordance with the invention;

FIG. 15 is a cross sectional view of the ceiling embodiment illustrated in FIG. 14;

FIG. 16 is a perspective view of a third embodiment of a ceiling configuration in accordance with the invention;

FIG. 17 is a cross sectional view of the ceiling configuration illustrated in FIG. 16;

FIG. 18 is a perspective view of a fourth embodiment of a ceiling configuration in accordance with the invention;

FIG. 19 is a cross sectional view of the ceiling configuration illustrated in FIG. 18;

FIG. 20 is a perspective view of a fifth embodiment of a ceiling configuration in accordance with the invention;

FIG. 21 is a cross sectional view of the ceiling configuration illustrated in FIG. 20;

FIG. 22 is a perspective view of a sixth embodiment of a ceiling configuration in accordance with the invention;

FIG. 23 is a cross sectional view of the ceiling configuration illustrated in FIG. 22;

FIG. 23A is an enlarged portion of the cross sectional view illustrated in FIG. 23;

FIG. 24 is a perspective view of a seventh alternative embodiment of a ceiling configuration in accordance with the invention;

FIG. 25 is a cross sectional view of the ceiling configuration illustrated in FIG. 24, with marker lights being shown;

FIG. 25A is an enlarged portion of the cross sectional view illustrated in FIG. 24;

FIG. 26 is a perspective view of an eighth alternative embodiment of a ceiling configuration in accordance with the invention;

FIG. 27 is a cross sectional view of the ceiling configuration illustrated in FIG. 26;

FIG. 27A is an enlarged view of the cross section illustrated in FIG. 27;

FIG. 28 is a perspective view of a ninth alternative embodiment of a ceiling configuration in accordance with the invention;

FIG. 29 is an underside view of the ceiling configuration illustrated in FIG. 28, and showing details of the fabric;

FIG. 30 is a cross sectional view of the ceiling configuration of FIG. 28, illustrating the support structure for the same;

FIG. 31 is a perspective view of an orientation of shielding elements which may be utilized in accordance with the invention;

FIG. 32 is an perspective view of an alternative embodiment of an orientation of shielding elements which may be utilized in accordance with the invention;

FIG. 33 illustrates the use of one of the embodiments of the ceiling configuration, utilized in combination with a dimmer control switch;

FIG. 33A is an elevation view of an example dimmer control switch;

FIG. 34 is a perspective view of a user exhibiting manual manipulation of a control wand for purposes of controlling the LED lighting modules of a ceiling configuration in accordance with the invention;

FIG. 35 is a perspective view of a user exhibiting manual manipulation of the control wand, for purposes of controlling functional relationships between a dimmer control switch and a ceiling configuration;

FIG. 36 is a perspective view of a control wand which may be utilized for the purposes illustrated in FIGS. 34 and 35;

FIG. 37 is an elevation view of the control wand illustrated in FIG. 36; and

FIG. 38 is an end view of one end of the wand illustrated in FIGS. 36 and 37.

DETAILED DESCRIPTION OF THE INVENTION

The principles of the invention are disclosed, by way of example, within a visual shield system 100 initially shown in FIG. 1 and illustrated in various embodiments in FIGS. 1 – 38. FIG. 1 illustrates a general layout of the ceiling system 100 as it may be utilized above a

workplace 102. The ceiling system 100 in accordance with the invention provides for an open system to physically change a family of products, including the capability of relocation. In addition, digital control and digital programming is also provided for the ceiling system 100. This control is utilized to undertake activities such as to change the ceiling system appearance for purposes such as personal design, identity of a particular group, personalization by color change, digital imaging, and projection of images. As described in subsequent paragraphs herein, the ceiling system 100 may be linked to a digital programming network.

Still further, ceiling systems in accordance with the invention provide for interchangeable shielding elements and interchangeability of other parts, which is essentially what could be characterized as a "mass customization." Unique visuals can be provided within the system. The system can also be fabricated in a relatively efficient manner, with support being provided by frames for the shielding elements. Because of the configuration of ceiling systems in accordance with the invention, relatively larger shielding elements can be utilized. In this regard, the shielding elements can be constructed of compressed polyester fiber material.

In the same regard, changes can be made to occur based on external environmental characteristics, such as the color of the sky and time of day. Changes in light may also be provided in accordance with the ceiling system during different seasons and the like. It is well known that lighting changes can be beneficial for the health and well being of individuals working under certain lighting structures.

Still further, ceiling systems in accordance with the invention take advantage of advancements in semiconductors and miniaturization of electronic components. That is, ceiling systems in accordance with the invention provide for a harnessing of solid state technology to

architectural activities. These advancements in technologies have resulted in changes in the way we work, and it is advantageous for ceiling systems to take advantage of such new work habits.

As illustrated in FIG. 1, the workplace 102 may include a series of conference tables 104 and chairs 106. However, the ceiling system 100 may be utilized in any of variously configured commercial interiors. As illustrated in FIG. 1, the ceiling system 100 may include a series of shielding elements 108 supported in any convenient manner through the use of frames 110 and cross frames 112. The ceiling system 100 may be suspended from a building roof or similar overhead structure (not shown) through the use of suspension cables 114 or comparable elements.

As described in subsequent paragraphs herein, the ceiling system 100, and its various embodiments, may employ LED (and other) lighting elements, with selectable materials surrounding lighting elements so as to provide varying degrees of translucence. The materials may be constructed and configured so as to accommodate additional utilities (e.g. sprinklers and the like) below a ceiling plane. More specifically, the ceiling configurations described herein in accordance with the invention provide a ceiling plane, with lighting elements and materials that are moveably mountable to the ceiling plane. The materials have varying degrees of translucence so as to adjust intensity and diffusion of light projected from the ceiling plane.

Still further, and in accordance with the invention, the ceiling system 100 and its various embodiments may employ lighting elements other than LED elements. For example, where LED lighting elements are described in subsequent paragraphs herein, lighting elements such as fluorescent lighting, metal halide lighting and various other types of lighting may be employed, without departing from the principal concepts of the invention. Still further, as referenced herein, the materials of the ceiling system 100 may be constructed so as to

accommodate additional utilities below a ceiling plane, with the utilities including sprinklers and the like. In addition to accommodating the utilities below the ceiling plane, the materials of which the ceiling system 100 is constructed may have sufficient openings or porosity so as to permit utilities such as sprinklers and the like to be maintained above a ceiling plane formed by these materials of the ceiling system 100. In this regard, many building codes provide that sprinklers and the like may be accommodated above the ceiling plane, if the plane exhibits total porosity openings of 70% or more.

Permeating throughout the inventive concepts of the ceiling system 100 are the issues associated with what may be characterized as "anticipatory design" or flexibility. That is, at the time that a designer may complete a structural and functional design for a commercial interior (including not only wall structures, but also locations of ceiling shielding elements, electrical fixtures, data nodes, communication outlets and the like), it may be several years before particular tenants occupy the structure. Between the time of the design completion and the time the particular tenants wish to occupy the structure, the prospective tenants' needs may be substantially different from the designers' anticipatory ideas. However, most commercial interior structures permit little reconfiguration of architectural elements and structure, after completion of an initial design. Reconfiguring a structure for the needs of a particular tenant can be extremely expensive and time consuming. During the structural modifications, the commercial interior is essentially "down" and provides no positive cash flow to the structure's owner.

However, with the ceiling system 100 in accordance with the invention, reconfiguration is facilitated, both with respect to expense and time. Essentially, the architectural interior can be reconfigured in "real time." In this regard, not only is it important that various functional components can be quickly relocated from a "physical" sense, but also

that "functional relationships" among components can be altered. As a relatively simple example, and as described in subsequent paragraphs herein with respect to FIGS. 34 and 35, functional or "control" relationships can be readily modified among various switch and lighting components. With respect to the relationships, alteration can occur with respect to aesthetic appearance. As earlier mentioned, it can be beneficial (from both a physical and mental health view point) to an individual to have certain types of lighting available. These capabilities of changes in appearance aesthetics occur both with respect to the capability of changing shielding planes, and from changing lighting.

More specifically, and with reference to FIG. 2, a perspective view is shown of a pair of shielding elements 116 which are supported through the use of a rail system which may comprise a pair of parallel and spaced apart rails 118. An exemplary embodiment of a rail system having rails such as rails 118 which may be employed with the shielding elements 116 is described in commonly assigned U.S. Provisional Patent Application Serial No. 60/408,149, entitled "Rail System" and filed on September 4, 2002. The rails 118 themselves may be suspended through the use of suspension cables or support rods 121 to overhead building supports (not shown). As further illustrated in FIG. 2, the shielding elements 116 may include coverings 120, examples of which are described in subsequent paragraphs herein. The coverings 120 may provide various translucence for a series of LED lighting module strips 122 and other types of lighting elements. Such LED lighting module strips 122 will also be described in subsequent paragraphs herein. The shielding elements 116 are supported on the sides of each of the adjacent rails 118 on a pair of opposing L-shaped brackets 124. Preferably, the shielding elements 116 may be releasably secured to the L-shaped brackets 124 through appropriate securing means such as connecting screws and the like.

In addition to the shielding elements 116 comprising shielding elements having translucent material coverings 120 and LED lighting modules 122, the shielding elements 116 may also comprise other elements. For example, other types of materials may be utilized as the shielding elements 116. For example, the shielding elements 116 may comprise air-filled cellular structures. In addition, such shielding elements may comprise 3D-Pongi fabric. Still further, these shielding elements 116 may comprise rigid fins or, alternatively, heliofon fabric fins. Further, the shielding elements 116 may be supported on their sides through the use of a frame 126 which may, for example, consist of various materials, including extruded aluminum.

FIG. 3 is similar in scope to FIG. 2, in that it illustrates a pair of shielding elements 116. However, in place of the use of rails 118 and support rods 121, the shielding elements 116 are supported from overhead building supports through the use of suspension cables 130 interconnected directly to the shielding elements 116 rather than through the use of rails 118. Preferably, the suspension cables 130 are adjustable in length. With adjustability of the length of the suspension cables, the supporting infrastructure and/or the shielding elements 116 themselves may be adjustable in distance from overhead building supports. Still further, interconnection between the shielding elements 116 and the rails 118 and support rods 121 may be constructed so that the shielding elements 116 are adjustable in vertical distance relative to the rails 118 and support rods 121.

FIG. 4 is a side elevation cross sectional view of the system shown in FIG. 2. FIG. 4 illustrates the support rod 121 and rail 118. The rail 118 will not be described in great detail herein. In general, the rail 118 may include cable trays 132 carrying communication cables 134 or the like. Support brackets 136 may be interconnected to a main track 138 at spaced apart intervals. The L-shaped brackets 124 may be interconnected to the main track 138

by any number of conventional securing means, such as bolt-nut combinations, connecting screws and the like. As earlier stated, a rail system having rails 118 is described in greater detail in the commonly assigned U.S. Provisional Patent Application Serial No. 60/408,149, entitled "Rail System" and filed on September 4, 2002.

FIG. 4 also illustrates the cross frames 126, interconnected to other components through the use of brackets 140. FIG. 4 further illustrates the positioning of the members 142 in a spaced apart and parallel configuration along the shielding elements 116. Mounted below the members 142 are LED lighting modules 144, which are mounted in any convenient manner on the underside of the members 142. Surrounding the LED lighting modules 144 are a series of "light bags" 146, which may have various degrees of translucency. It is these light bags 146 and other embodiments as set forth in subsequent paragraphs herein which provide modifications to light intensity and varying degrees of translucency and diffusion with respect to the LED lighting modules.

FIG. 5 is a side elevation cross-sectional view of the configuration illustrated in FIG. 3. That is, FIG. 5 illustrates the use of suspension cables 130. The suspension cables 130 depend downwardly and are received within apertures in the cross bracket 140 and in an L-shaped bracket 148. An end cap 150 is utilized to secure the suspension cable 130 to the brackets 140, 148.

FIG. 6 is a perspective view (looking from underneath) of one of the elongated LED members 142 which may be employed with the shielding elements 116. As illustrated in FIG. 6, the member 142 is elongated in length and will laterally extend across a shielding elements 116. Mounted to the lower portion of the LED member 142 is a linear LED lighting module 144. The linear LED lighting module 144 is also elongated in length and secured by any

of a number of conventional securing means (such as adhesives, connecting screws or the like) to the underside of the member 142. The linear LED lighting module 144 is positioned so that it extends longitudinally along the length of the member 142. The linear LED lighting module 144 includes a series of LED's 152 spaced apart along the length of the linear LED lighting module 144.

FIG. 7 is an illustration similar to FIG. 6, but illustrates the use of two linear LED lighting modules 144. Correspondingly, FIG. 8 is similar to FIGS. 6 and 7, but illustrates the use of three linear LED lighting modules 144 along the length of the member 142. FIG. 9 is an underside elevation view of the member 142 and three linear LED lighting modules 144 as illustrated in FIG. 8. FIG. 10 is an illustration of a linear LED lighting module 144, separate and apart from any member 142. FIG. 10 illustrates that the linear LED lighting module 144 may be flexible in construction, and may be constructed of any of a number of suitable materials. Also, although not expressly shown in the drawings, low voltage DC power may be applied to the LED's 152 of the LED lighting module through wires or other conductors embedded within the length of the linear LED lighting module 144.

FIG. 11 is substantially similar in scope to FIG. 4. That is, FIG. 11 illustrates a rail 118 having cable trays 132 carrying communication cables 134. FIG. 11 also illustrates the use of the support rod 121, which is interconnected to the main track 138. Support brackets 136 are utilize to interconnect sections of the main track 138.

In addition, FIG. 11, like FIG. 4, illustrates the use of an L-shaped bracket 124 and cross bracket 140 for interconnection of the shielding elements 116 to the rail 118. However, unlike FIG. 4, the configuration illustrated in FIG. 11 also includes a power transformer 160 which may be interconnected to electrical components in any suitable manner

which are either associated with the rail 118 or otherwise configured around the rail 118 and shielding elements 116. The power transformer 160 may be utilized to supply low voltage DC power through power cord 162 to the linear LED lighting modules 144. FIG. 11 illustrates the use of bus bars 164 to supply low voltage DC power to the linear LED lighting modules 144 and LED's 152. However, it may be preferable to employ a series of cables and wires (not expressly shown in FIG. 11) for purposes of providing electrical power to each of the linear LED lighting modules. The interconnection between the power cord 162 and the bus bars 164 or appropriate wiring can be made in any conventional manner. Correspondingly, the electrical interconnection between the bus bars 164 or wiring and the LED's 152 of the linear LED lighting modules 144 may also be made in a conventional manner. FIG. 11A illustrates greater detail with regard to the configuration of FIG. 11, and comprises a sectional end view of certain components of FIG. 11, taken along section lines 11A - 11A of FIG. 11.

As earlier stated, ceiling systems in accordance with the invention may utilize LED and other lighting elements, along with selectable materials which will surround the lighting elements so as to provide varying degrees of translucence. The selectable materials may be digitally cut for purposes of forming the same. The selectable materials will also be utilized to modify the intensity and the diffusion of light projected from the LED or other lighting elements. FIGS. 12 - 30 illustrate various configurations in accordance with the invention. Turning to these drawings, FIGS. 12 and 13 illustrate a ceiling configuration 200. The ceiling configuration 200 may be characterized as employing light diffusing fabric fins, with light bags. More specifically, the configuration 200 includes a series of members 142, each having a linear LED lighting module 144 secured to the underside thereof. Each of the linear LED lighting modules 144 includes a series of spaced apart LED lights 152. Suspended in any appropriate

manner from the members 142 are a series of light bags 210. The light bags 210 serve to provide light diffusion and a particular level of translucence. In accordance with one aspect of the invention, the light bags 210 may comprise light diffusion heliofon fabric. Such fabric is commercially available.

FIGS. 14 and 15 illustrate a second ceiling configuration 220. In this particular configuration, light diffusing fabric fins again are employed. However, in this case, the fins are in the form of a singular light sheet 230 which may be "wrapped" around the light members 142. Ends of the light sheets 230 may be secured together by any suitable means. In this case, the light sheets 230 may also comprise light diffusing heliofon fabric. Again, such fabric is commercially available. However, in addition, the fabric dimensions may be customized through the use of digital cutting by the end user.

FIGS. 16 and 17 illustrate another alternative embodiment of a ceiling configuration in accordance with the invention, identified as ceiling configuration 240. In this particular configuration, ceilings are utilized which are in the form of rigid fins 250. The fins 250 may be secured in any appropriate manner to the lower portions of the LED members 142. In this case, the rigid fins 250 form, as illustrated in FIG. 17, what would be characterized as "deep triangles." In this particular instance, the rigid fins 250 in accordance with the invention may be composed of a translucent Lexan® material.

FIGS. 18 and 19 illustrate a further ceiling embodiment comprising the ceiling configuration 260. As shown in FIGS. 18 and 19, the ceiling configuration 260 includes a pair of relatively long rigid fins 270, which essentially form a rectangular configuration. Intermediate the two rigid fins 270 associated with each member 142 is a rigid fin 290 of intermediate length, and a rigid fin 280 of relatively shorter length. The fins 280 and 290 separate a series of three

linear LED lighting modules 144 from each other. Again, the rigid fins 270, 280 and 290 may consist of a translucent Lexan® material.

FIGS. 20 and 21 illustrate another embodiment of a ceiling configuration, identified as ceiling configuration 300. In this particular instance, a series of rigid fins 310 form a rectangular configuration around individual ones of the linear LED lighting modules 144. However, unlike certain of the other ceiling embodiments described herein, embodiment 300 is configured so that each linear LED lighting module 144 is turned on its side, with the strips of LED's 152 have a different directional configuration. In this case, the ceiling configuration 300 includes the rigid fins 310 in a rectangular configuration, with the fins 310 also being constructed of a translucent Lexan® material.

FIGS. 22, 23 and 23A illustrate a further ceiling configuration 320 which may be utilized in accordance with the invention. As illustrated in these drawings, the ceiling configuration 320 includes a series of parallel and spaced apart linear air tubes 330. The linear air tubes 330 are mounted so that a series of members 142 and attached linear LED lighting modules 144 are spaced intermediate the linear air tubes 330. Although not expressly shown in the drawings, the LED members 142 may be mounted in any appropriate means to the frame 126. For purposes of providing the linear air tubes 330, polyethylene air tubes may be utilized. Such air tubes are commercially available.

With respect to each of the ceiling embodiments described herein, it should be emphasized that the specific embodiments do not show details relating to powering of the linear LED lighting modules. However, power can be supplied to the lighting modules as described with respect to previous drawings herein. Further, a number of different arrangements for providing power to the linear LED lighting modules may be utilized.

FIGS. 24, 25 and 25A illustrate a further ceiling configuration 340. The configuration 340 is somewhat similar to that illustrated in FIG. 22, in that the configuration 340 utilizes linear air tubes 350 for purposes of providing the ceilings. However, unlike FIG. 22, the ceiling embodiment 340 also utilizes what are referred to as round marker LED lighting modules 360. Such lighting modules 360 have a structural configuration as primarily illustrated in FIGS. 25 and 25A. Again, the linear air tubes 350 may be constructed of polyethylene air tubes.

FIGS. 26, 27 and 27A illustrate a further embodiment of a ceiling configuration in accordance with the invention, identified as ceiling configuration 400. In this particular instance, the ceiling configuration 400 employs round marker LED lighting modules 360, corresponding to the round marker LED lighting modules 360 previously described with respect to FIGS. 24, 25 and 25A. However, unlike the ceiling embodiment 340 illustrated in FIG. 24, the ceiling embodiment 400 employs ceilings which may be characterized as air pillows 410. Both the round marker LED lighting modules 360 and the air pillows 410 are commercially available. Preferably, the air pillows 410 may be constructed of a polyethylene material. The air pillows 410 and the round marker LED lighting modules 360 provide a still different translucency and light diffusion.

FIGS. 28, 29 and 30 illustrate a further embodiment of a ceiling configuration in accordance with the invention. More specifically, FIGS. 28, 29 and 30 illustrate a ceiling configuration 450 which utilizes a series of woven fabric materials 460. These woven fabric materials 460 may be of any of a number of different fabrics, and may be suspended in a manner so as to provide a "wave" pattern as illustrated in FIGS. 28 and 29. In addition, for purposes of aesthetics, forced air may be circulated around the fabrics 460, and the same may be suspended or otherwise hung so as to generate "pulsing" curvatures as a result of the airflow. Positioned

above the fabrics 460 are members 142 having any of a number of different types of LED lighting modules 470 associated therewith. For example, the LED lighting modules 470 could be in the form of linear LED lighting modules or, alternatively, round-marker LED lighting modules, each as previously described herein.

FIGS. 31 and 32 illustrate the concept that the ceiling configurations do not necessarily have to be located in horizontal planes. FIGS. 31 and 32 each show a horizontal plane A, for purposes of orientation. Each of these drawings also shows a series of shielding elements 116 (which may incorporate any of the embodiments previously described herein), suspended from suspension cables 130. As illustrated in FIG. 32, the shielding elements 116 may be of varied angular orientation, with the shielding elements interconnected through flexible or hinged frames 500.

As earlier referenced herein, the ceiling configurations may be provided with means for facilitating control and reconfiguration of controlled relationships among various functional components which may be utilized with the ceiling configuration. For purposes of describing the concept of establishing controlling relationships among various controlled and controlling components which may be associated with the ceiling configurations, reference is made to the commonly assigned U.S. Provisional Patent Application Serial No. 60/374,012 entitled "Switching/Lighting Correlation System" and filed April 19, 2002. The contents of the aforedescribed patent application are hereby incorporated by reference herein.

With respect to the ceiling configurations described herein, most of these configurations made reference to LED lighting elements. That is, the ceiling configurations may be categorized as being available in an "unlit" format and a "lit" format. As earlier described herein, various other types of lighting elements may be utilized, such as fluorescent, metal halide

and similar elements. Further, various types of acoustical control or absorption concepts may be employed with ceiling systems in accordance with the invention. Still further, with respect to security and safety, the shielding elements may be constructed of fire resistant or fire proof materials. Still further, the LED lighting elements and other lighting elements which may be utilized in accordance with the invention can comprise various colors. In addition, the colors of the lighting elements can be physically and/or electrically controlled.

In this regard, it would be favorable to establish control relationships among switches and lights, and have the capability of reconfiguring the same. Other control relationships may also be worthwhile. For example, FIGS. 33 and 33A illustrate a ceiling configuration 520 utilizing light bag elements 530 similar to those previously described herein. As also shown in FIG. 33, the linear LED lighting modules 144 may be coupled to a power cord 530 which, in turn, is coupled to a switch stand 530. As with other ceiling configurations previously described herein, the ceiling configuration 520 may employ other types of lighting elements, such as fluorescent, metal halide and similar elements. The switch stand 530 includes a dimmer configuration 550, having an enabling switch 552 and a dimmer control 554. With respect to this configuration, FIG. 34 illustrates a user employing a control wand 560 (to be described in subsequent paragraphs herein) for purposes of establishing control of the linear LED lighting modules 144 associated with the ceiling configuration 520. In this case, the control wand 560 may be pointing to an IR receiver (not shown) for executing certain control functions. FIG. 35 illustrates the user projecting the control wand 560 toward the dimmer configuration 550. The dimmer configuration 550 may have an IR receiver, for purposes of receiving IR signals 562 from the control wand 560. In this case, and as described in U.S. Provisional Patent Application Serial No. 60/374,012, entitled "Switching/Lighting Correlation System" and filed

April 19, 2002, the user may be employing the control wand 560 so as to establish that the dimmer configuration 550 will be controlling the linear LED lighting modules 144 of the ceiling configuration 520. Further, the control wand 560 may be used to reconfigure various shielding elements themselves.

With respect to concepts associated with control, it is also possible to utilize ceiling systems in accordance with the invention with systems which employ vertically disposed space dividers and the like. An example of such a system is disclosed in U.S. Provisional Patent Application Serial No. 60/408,011, entitled "Partition System with Technology" and filed September 4, 2002.

An example of the control wand 560 is illustrated in FIGS. 36, 37 and 38. With reference thereto, the control wand 560 may be of an elongated configuration. At one end of the control wand 560 is a light source 570 which, preferably, would generate a substantially collimated beam of light. In addition to the light source 570, the control wand 560 may also include an infrared (IR) emitter 580, for transmitting infrared transmission signals to corresponding IR receivers associated with the ceiling configuration 520 and the dimmer configuration 550, in addition to other elements which may be utilized with other functional accessories.

The control wand 560 may also include a trigger 590, for purposes of initiating transmission of IR signals. Still further, the wand 560 may include mode select switches, such as mode select switch 600 and mode select switch 602. These mode select switches 600, 602 may be utilized to allow manual selection of particular commands which may be generated using the wand 560. The control wand 560 may also use controllers (not shown) or similar computerized devices, for purposes of providing electronics within the wand 560 for use with the trigger 590,

mode select switches 600, 602, light source 570 and the IR emitter 580. As earlier mentioned, an example of use of such a wand, with the control commands which may be generated using the same, is described in commonly assigned U.S. Provisional Patent Application Serial No. 60/374,012, entitled "Switching/Lighting Correlation System" and filed April 19, 2002.

Referring back to FIGS. 34 and 35, the user may employ the wand 560 to transmit signals to a controller (not shown) associated with the dimmer configuration 550 and the ceiling configuration 520. The capability of essentially "programming" controlled relationships among the various accessories associated with the ceiling configurations requires a capability of transmitting and receiving communication signals among the various functional accessories. In this regard, infrastructure systems may be employed. An example of such an infrastructure system which may be employed with the ceiling configurations in accordance with the invention is described in detail in the commonly assigned U.S. Provisional Patent Application Serial No. 60/408,149, entitled "Rail System" and filed September 4, 2002.

It will be apparent to those skilled in the pertinent arts that other embodiments of ceiling systems in accordance with the invention may be designed. That it, the principles of a ceiling system are not limited to the specific embodiments described herein. Accordingly, it will be apparent to those skilled in the art that modifications and other variations of the above-described illustrative embodiments of the invention may be effected without departing from the spirit and scope of the novel concepts of the invention.